Published in final edited form as:

Am J Health Syst Pharm. 2017 December 15; 74(24): 2054–2059. doi:10.2146/ajhp160348.

Randomized controlled evaluation of an insulin pen storage policy

Haley G. Gibbs, Pharm.D., M.P.H.,

Department of Pharmacy, Wake Forest Baptist Medical Center, Winston-Salem, NC

Tara McLernon, B.S.N., RN,

School of Nursing, University of Northern Colorado, Greeley, CO

Rosemary Call, Pharm.D.,

Department of Pharmacy, Johns Hopkins Hospital, Baltimore, MD

Katie Outten, M.S.N., RN,

Department of Medicine, Johns Hopkins Hospital, Baltimore, MD

Leigh Efird, Pharm.D., M.P.H.,

Department of Pharmacy, NewYork-Presbyterian Hospital, New York, NY

Peter A. Doyle, Ph.D.,

Clinical Engineering Services, Johns Hopkins Hospital, Baltimore, MD

Elizabeth A. Stuart, Ph.D.,

Department of Mental Health, Department of Biostatistics, and Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Nestoras Mathioudakis, M.D., M.H.S.,

Division of Endocrinology, Diabetes, and Metabolism, Johns Hopkins School of Medicine, Baltimore, MD

Nicole Glasgow, Pharm.D.,

Department of Pharmacy, Johns Hopkins Hospital, Baltimore, MD

Avadhut Joshi, Ph.D., Pharm.D.,

Translational Software, Inc., Bellevue, WA

Pravin George, D.O.,

Department of Neurology, Division of Anesthesia and Critical Care Medicine, Johns Hopkins Hospital, Baltimore, MD

Bob Feroli, Pharm.D., and

Department of Pharmacy, Johns Hopkins Hospital, Baltimore, MD

Elizabeth K. Zink, M.S., RN

Department of Neuroscience Nursing, Johns Hopkins Hospital, Baltimore, MD

Address correspondence to Dr. Gibbs (hgibbs@wakehealth.edu).

Disclosures

The authors have declared no potential conflicts of interest.

Abstract

Purpose—Results of a quality-improvement project to enhance safeguards against “wrong-pen-to-patient” insulin pen errors by permitting secure bedside storage of insulin pens are reported.

Methods—A cluster-randomized controlled evaluation was conducted at an academic medical center to assess adherence with institutional policy on insulin pen storage before and after implementation of a revised policy allowing pen storage in locking boxes in patient rooms. In phase 1 of the study, baseline data on policy adherence were captured for 8 patient care units (4 designated as intervention units and 4 designated as control units). In phase 2, policy adherence was assessed through direct observation during weekly audits after lock boxes were installed on intervention units and education on proper insulin pen storage was provided to nurses in all 8 units.

Results—Phase 1 rates of adherence to insulin pen storage policy were 59% in the intervention units and 49% in the control units ($p = 0.56$). During phase 2, there was no significant change from baseline in control unit adherence (67%, $p = 0.26$), but adherence in intervention units improved significantly, to 89% ($p = 0.005$). Common types of observed nonadherence included pens being unsecured in patient rooms or nurses’ pockets or left in patient-specific medication drawers after patient discharge.

Conclusion—An institutional policy change permitting secure storage of insulin pens close to the point of care, paired with nurse education, increased adherence more than education alone.

Keywords

insulin; nurses; patient safety; policy guideline adherence

Unsafe insulin use continues to challenge hospitals nationwide. The Institute for Safe Medication Practices (ISMP) classifies insulin as a high-alert medication, meaning it has the potential to cause “significant patient harm” if used in error.¹ Medication errors involving use of insulin vials in hospitals have been documented and have caused severe harm to patients.^{2–4}

Many institutions have transitioned away from administering insulin via vials and syringes toward using insulin pens due to the risk of overdose with use of insulin vials.⁵ There have been multiple reported incidents involving insulin vials wherein health-care workers or patients inadvertently administered the wrong dose of insulin due to misinterpretation or miscalculation of the insulin concentration or inappropriate use of noninsulin syringes. Research has shown that patients using insulin vials were more likely to have hypoglycemic events than patients using insulin pens.⁶

Insulin pens offer several advantages over vials, including ease of use, dosing accuracy, and decreased healthcare costs.^{7–9} Despite the numerous advantages of insulin pens, some hospitals are switching back to vials due to the inappropriate practice of insulin administration via a single pen to more than 1 patient; this misuse has occurred in multiple hospital settings and has prompted the Food and Drug Administration (FDA) to issue statements warning against the use of a single injector pen to give insulin to multiple

patients.¹⁰ There is a potential for transmission of infection if a single insulin pen is used to administer insulin to multiple patients regardless of whether a new needle is used for each patient.¹¹ As a result of these safety concerns, ISMP issued a statement urging hospitals to eliminate inpatient insulin pen use due to continued reports of patients being placed at risk for infection despite educational and monitoring efforts.¹²

Transitioning back to insulin vials is concerning given the documented incidents of insulin overdoses, including deaths. The potential problems with insulin pen use are not impossible to overcome, and successful use in hospitalized patients can be achieved. Safe use of insulin pens includes the development of policies and realistic procedures for insulin administration, continuous education and monitoring, and safe storage to reduce the risk of transmitting infectious diseases through “wrong-pen-to-patient” administration. Our objective was to evaluate the implementation of a new institutional policy allowing secure in-room storage of insulin pens. The primary endpoint of the study was policy adherence.

Background

Johns Hopkins Hospital is a large academic medical center that has 2 types of insulin pens on formulary: pens containing short-acting insulin (insulin aspart) and pens containing long-acting insulin (insulin glargine). In an effort to decrease the risk of wrong-pen-to-patient errors, several years ago the institution implemented a policy requiring storage of insulin pens in patient-specific medication drawers in medication rooms on each unit between insulin administrations. However, bedside nurses indicated that this was not conducive to efficient workflow, as many patients are on insulin therapy requiring multiple doses per day and medication rooms are often not close to patients’ rooms. Nurses are interrupted, on average, almost 7 times per hour, leading to situations that increase the chance of a nurse inadvertently leaving a pen unsecured in a patient’s room or in the nurse’s pocket, thus increasing the risk of insulin administration to a wrong patient.¹³

In order to address the problems with the original insulin pen policy, we examined the implementation of a new policy that involved mounting a clear locking box on a wall in each patient room for secure storage of patient-specific insulin pens and creating a new policy allowing storage of insulin pens in these boxes. Using the concept of *temotoka* (Japanese for “close at hand”) in lean quality-improvement methodology, which in part describes efforts to reduce physical distance between a person completing work and the materials required, we sought to improve nursing workflow for insulin administration by reducing the distance between the insulin pen and the intended patient.¹⁴ While the expected outcome of this policy change was to reduce the number of wrong-pen-to-patient errors, measuring the true rate of errors, which are only identifiable through self-reporting, was not possible; we thus used a surrogate outcome, policy adherence.

Methods

The study was a cluster-randomized, controlled, longitudinal evaluation conducted in 8 units in a large academic medical center. The primary objective was to compare the rate of adherence to the new policy on insulin pen storage with the rate of adherence to the former

policy. In addition, we sought to characterize inappropriate pen storage in incidents of policy nonadherence.

On institutional review board assessment, the study was acknowledged as a quality-improvement initiative; the study was approved by the nursing division directors and unit managers of all units participating in the evaluation.

Intervention

Prior to the study, hospital policy required that insulin pens be stored in patient-specific medication drawers located in medication rooms on nursing units at all times other than the time of insulin administration. Each unit has a medication room separate from the patient rooms. The intervention consisted of a policy change permitting insulin pen storage in patient rooms in clear, wall-mounted, locking boxes (RegulatoR Insulin Pen Box, Health Care Logistics, Inc., Circleville, OH; shown in Figure 1). Personnel on all units, both those targeted for the intervention and those not targeted, received education, as described below; both policies allowed for the storage of insulin pens in a patient-specific medication drawer. For all units and in all phases of the intervention, insulin pens were dispensed by the pharmacy directly to patient-specific medication drawers. Consistent with hospital policy, nurses were responsible for ensuring that insulin pens were transferred with patients to different units or discarded appropriately at patient discharge.

Unit selection and randomization

The 2 intensive care units (ICUs) and the 6 non-ICU units with the highest frequencies of insulin pen use in the hospital, as measured by cross-sectional reviews on 3 occasions, were selected for inclusion in the study. The 8 units, stratified by level of care (ICU versus non-ICU), were randomly assigned to be either intervention ($n = 4$) or control ($n = 4$) units at the beginning of the study period.

Timeline

The evaluation consisted of 2 phases. In phase 1, baseline data were captured from all 8 units prior to the policy change or nurse education (or both). In phase 2, data were captured after the new policy was implemented on the 4 intervention units and after nursing staff on all 8 units received education delivered by the study team.

Each phase of the study lasted roughly 4 weeks, and audits were performed as often as twice weekly during each phase. During the 1-month interval between phases, the clear, locking storage boxes were installed on the 4 intervention units, with subsequent implementation of the revised insulin pen storage policy on those units. On all 8 units, education on appropriate insulin storage policy, including what to do with insulin pens upon patient transfer or discharge, was provided. In order to be consistent in the education provided to both groups, 2 separate 2-minute videos, each showing a nurse performing the appropriate process for insulin storage (per intervention or control policy), were constructed; a study team member displayed the videos on nursing units at times selected by the unit nurse managers. Education was provided to staff on all 8 units during the same time period to control for the

impact of education on the primary and secondary endpoints. No ongoing education was provided during phase 2.

After phase 1 and phase 2 data were collected, an additional, unplanned phase of data collection (phase 3) was performed to evaluate the new policy longitudinally, specifically to determine if it was performing better than at baseline or during study phase 1; this phase was requested by the hospital leadership. Because this phase was not planned at the beginning of the study, phase 3 data were not included in our primary analysis but are described in the results section.

Measurement

To assess adherence to the policy, direct audits were performed by a study observer. In the context of our study, “audit” refers to collection of data for a single unit at a specific date and time, which were largely chosen on the basis of observer availability; however, care was taken so that all audits were not performed on the same day of the week or time of day. In addition, the observer tried to avoid auditing at times likely to correspond with standard insulin administration times. Each audit began with a manual medication order review by the observer and documentation of the number of active insulin pen orders per patient. Next, all patient-specific medication drawers were inspected regardless of active bed assignment or active pen orders. The observer then proceeded to survey all patient rooms, occupied and unoccupied, to determine if insulin pens were present. This process was carried out in all phases of the study, with the addition of inspections of insulin storage boxes on intervention units during phases 2 and 3. If a patient had active insulin pen orders but no insulin pen could be found in the patient-specific medication drawer, in the insulin pen storage box, or elsewhere in the patient’s room, then the observer asked the patient’s nurse about the location of the insulin pens. Pen storage was determined to be policy adherent if a pen was in the correct patient’s assigned medication drawer (all participating units during all study phases) or the clear insulin storage box in the correctly assigned patient’s room (intervention units during phases 2 and 3) or if an insulin pen dose was being actively administered by a nurse to the correct patient at the bedside (all units during all phases). If a pen was not in an appropriate place, its location was further characterized (e.g., unsecured at the correct patient’s bedside, at the incorrect patient’s bedside, in a nurse’s pocket, in the incorrect patient-specific medication drawer).

Percent adherence was calculated for each audit as the number of pens in the correct place divided by the number of active orders for insulin pens per unit on the date and at the time of the audit and multiplied by 100. Only a single pen of each insulin type per patient was considered during audits. For example, if a patient had orders for both insulin aspart and insulin glargine pens, both types of pens were included in the analysis. However, in the event that multiple pens of the same type of insulin prescribed to a single patient (e.g., 2 insulin aspart pens) were found in separate places, only the incorrectly located pen (or pens) was counted.

Statistical analysis

The primary analysis was performed using a multilevel difference in differences (DD) model, with a random intercept for each nursing unit, to evaluate the effect of the new policy on policy adherence while accounting for the clustering of audits within hospital units. The unit of observation for this analysis was percent adherence calculated for each audit. The model predicted percent adherence as a function of study group; or arm (intervention versus control), study phase (1 versus 2); and the interaction term *arm*phase*. This model was chosen via a model selection strategy using a likelihood ratio test that also considered a model allowing for linear time trends; as this test indicated that the more complex linear-trending model was not a significantly better fit than the simpler DD model ($p = 0.85$), the latter model was chosen. Estimates of percent adherence and confidence intervals (CIs) were then calculated for intervention and control units during each phase using the coefficients of the DD model. This same analytic technique was used to compare phase 1 and phase 3 results. Here we also provide a descriptive analysis of the types of nonadherence. All analyses were performed using Stata 14 (StataCorp LP, College Station, TX).

Results

Phase 1 audits were conducted from February 14 through March 15, 2015. A total of 35 audits (18 on control units and 17 on intervention units) representing a total of 555 insulin pen orders (84% for insulin aspart) were performed. Phase 2 audits were conducted from April 10 through May 7, 2015, with a total of 32 audits (16 each on intervention and control units) representing a total of 507 insulin orders (82% for insulin aspart) performed. Phase 2 audits were performed 3–36 days after the first educational program was provided (on average, within 17 days for control units and 18 days for intervention units; $p = 0.60$). Seventy-nine percent of audits were performed Monday through Friday, and 76% were performed between 7 a.m. and 7 p.m.

Policy adherence

Overall rates of policy adherence in phase 1 were 59% (95% CI, 49–75%) in the control units and 49% (95% CI, 20–77%) in the intervention units, as calculated by the multilevel DD model; the difference in adherence rates at baseline was not statistically significant ($p = 0.56$). During phase 2, adherence increased to 67% (95% CI, 46–88%; $p = 0.26$) and 89% (95% CI, 76–100%; $p = 0.005$) in the control and intervention groups, respectively, and the magnitude of improvement from baseline was greater on intervention units ($p = 0.046$).

Policy nonadherence

The nature of observed insulin pen policy nonadherence is captured in Table 1. The most common type of nonadherence was pens being left unsecured in the correct patient's room, followed by pens being found in nurses' pockets and pens being left in patient-specific medication drawers in the medication room after patient discharge or transfer off the unit. Although fewer in number, incidents in which pens were found in incorrect patients' medication drawers or rooms also occurred. There was 1 instance of a pen being found in an incorrect storage box.

Phase 3 results

Phase 3 audits were performed from June 11 through June 29, 2015, with 16 observations representing 240 insulin orders conducted on the same 8 hospital units involved in study phases 1 and 2. Policy adherence rates were 61% and 89% on control and intervention units, respectively. Control unit adherence in phase 3 was statistically similar to baseline adherence ($p = 0.77$), but adherence on intervention units continued to be significantly better than at baseline ($p = 0.01$).

Discussion

Our evaluation of a quality-improvement intervention focused on insulin pen safety demonstrated improved adherence to insulin pen storage policy after a policy change to allow secure pen storage in patient rooms. The rate of policy adherence after insulin storage boxes were placed in patient rooms reached 89% on intervention units, resulting in a statistically greater improvement in adherence than was seen in the control group. This improvement in practice, which was sustained over time, has the potential to decrease wrong-pen-to-patient errors by keeping the correct pen closer to the point of care. Additionally, the baseline data collected prior to the intervention demonstrated that overall adherence to an existing policy requiring insulin pen storage in patient-specific medication drawers was low (59% and 49% on control and intervention units, respectively); the observed low overall adherence was consistent with our understanding of current practice, as such a policy does not fit well into nursing workflow, resulting in workarounds such as pens being stored unsecured at the bedside or in nurses' pockets.

Wrong-pen-to-patient insulin use has been reported in hospitals throughout the United States, with thousands of potential patient exposures reported since 2008.^{15–19} As a result, FDA, ISMP, the Centers for Disease Control and Prevention, and ASHP have issued warnings and recommendations regarding the safe use of insulin pens in the hospital setting.^{20–23} Those warnings include an ISMP recommendation against use of insulin pens in hospitals in 2013, which was reiterated after a multihospital evaluation of wrong-pen-to-patient errors subsequent to implementation of ISMP best-practice recommendations.²⁰ This recommendation was made despite the reported risk associated with vial and syringe use and the lack of associated disease transmission documented in the literature. In fact, 1 study found no cases of disease transmission associated with insulin administration via the vial and syringe method among 1,501 patients potentially exposed and subsequently tested.²⁴

Our intervention represents an approach different from previously studied approaches. The initial idea for the project was conceived by front-line nursing staff at the study site, who were concerned about their ability to comply with the original insulin pen storage policy even under the most favorable conditions. Our results show that by storing the medication closer to the patient, adherence to proper storage procedures can be increased.

We found that unsecured storage of insulin pens within the correct patient's room was the most common reason for policy nonadherence. Without a designated location such as the insulin pen storage box, an injector pen may be placed in various locations throughout the room, resulting in pen loss (necessitating the dispensing of additional pens), or left behind

on patient transfer, remaining in the room when a new patient occupies it. This finding emerged from audits during which pens were found in empty rooms and in patient-specific medication drawers within medication rooms after patient transfer or discharge. We hypothesize that such lapses in policy adherence contributed to the problem of incorrect pens being found at the bedside or within medication drawers; either situation increases the risk of wrong-pen-to-patient errors.

Given that we were unable to capture wrong-pen-to-patient errors in our study, we recommend close monitoring of the use of insulin pens and associated errors even if an intervention such as that described here is implemented. We believe the success of our intervention was achieved through an improvement in nursing workflow, which could only be achieved by working alongside nursing personnel. When designing medication-use policies, it is critical that pharmacists involve members of other affected healthcare disciplines in order to fully optimize the process.

Our study had important limitations. First, the impetus for the project was a desire to reduce the number of wrong-pen-to-patient errors, but erratic voluntary reporting of such errors made that an impractical and unreliable primary outcome. Thus, we have made the assumption that by improving policy adherence with regard to insulin pen storage, we can have a meaningful impact on these events. Using this type of surrogate outcome limits the ability to interpret the effect of a policy on patient harm. Another limitation of our study was the potential for failure to capture incidents of pen storage in inappropriate locations in cases involving duplicate pens for the same patient; for example, if a pen was in a nurse's pocket and a duplicate was properly stored in a medication drawer, then the observer, according to the study protocol, would not have approached the nurse to ask about the location of potential additional insulin pens. Our observers were not blinded to the intervention, as it was necessary for them to know which policy each unit was to follow in order to assess adherence. However, we believe our structured and objective approach to defining adherence limited the potential for bias due to lack of blinding. Additionally, it is possible that observers' weekly presence on units might have resulted in practice changes due to the Hawthorne effect. We found statistically significant improvements in policy adherence only on intervention units, suggesting that the Hawthorne effect was unlikely to have been responsible for our primary finding.

Conclusion

An institutional policy change permitting secure storage of insulin pens close to the point of care, paired with nurse education, increased adherence more than education alone.

Acknowledgments

The authors acknowledge and thank the 8 nursing units and their leaderships for participating in the quality-improvement project.

References

1. Institute for Safe Medication Practices. [accessed 2014 Apr 14] ISMP's list of high-alert medications. www.ismp.org/Tools/institutionalhighalert.asp

2. Amori RE, Pittas AG, Siegal RD, et al. Inpatient medical errors involving glucose-lowering medication and their impact on patients: review of 2,598 incidents from voluntary electronic error-reporting database. *Endocr Pract.* 2008; 14:535–42. [PubMed: 18753094]
3. Classen DC, Jasper L, Budnitz DS. Adverse drug events among hospitalized Medicare patients: epidemiology and national estimate from a new approach to surveillance. *Jt Comm J Qual Patient Saf.* 2010; 36:12–21. [PubMed: 20112660]
4. Cousins D, Rosario C, Scarpello J. Insulin, hospitals and harm: a review of patient safety incidents reported to the National Patient Safety Agency. *Clin Med.* 2011; 11:28–30.
5. Prescrire editorial staff. Insulin use: preventable errors. *Prescrire Int.* 2014; 145:14–7.
6. Asche CV, Luo W, Aagren M. Differences in rates of hypoglycemia and health care costs in patient treated with insulin aspart in pens versus vials. *Curr Med Res Opin.* 2013; 10:1287–96.
7. Asche CV, Shane-McWhorter L, Raparla S. Health economics and compliance of vials/syringes versus pen devices: a review of the evidence. *Diabetes Technol Ther.* 2010; 12:101–8.
8. Krzywon M, van der Burg T, Fuhr U, et al. Study on the dosing accuracy of commonly used disposable insulin pens. *Diabetes Technol Ther.* 2012; 14:804–9. [PubMed: 22694223]
9. Cornell S. Managing diabetes-related costs and quality of life issues: value of insulin analogs and pens for inpatient use. *Health Policy.* 2010; 3:191–9.
10. Food and Drug Administration. [accessed 2014 Apr 17] Insulin pens are not for sharing. www.fda.gov/forconsumers/consumerupdates/ucm129955.htm
11. Herdman ML, Larck C, Hoppe Schliesser S, et al. Biological contamination of insulin pens in a hospital setting. *Am J Health-Syst Pharm.* 2013; 70:1244–9. [PubMed: 23820462]
12. Institute for Safe Medication Practices. [accessed 2014 Apr 14] Hospitals should reconsider insulin pen use. www.ismp.org/newsletters/acutecare/issues/20130207.pdf
13. Biron AD, Loisel CG, Lavoie-Tremblay M. Work interruptions and their contribution to medication administration errors: an evidence review. *Worldviews Evid Based Nurs.* 2009; 6(2): 70–86. [PubMed: 19413581]
14. Yerian LM, Seestadt JA, Gomez ER, Marchant KK. A collaborative approach to lean laboratory workstation design reduces wasted technologist travel. *Am J Clin Pathol.* 2012; 138:273–80. [PubMed: 22904140]
15. Institute for Safe Medication Practices. [accessed 2017 Sep 9] Reuse of insulin pen for multiple patients risks transmission of bloodborne disease. Feb 12, 2009. www.ismp.org/newsletters/acutecare/articles/20090212-2.asp
16. Conley, M. [accessed 2015 Dec 28] Wis. clinic warns patients of possible bloodborne disease exposure. Aug 30, 2011. www.ismp.org/sc?id=419
17. Associated Press. [accessed 2017 Sep 9] Possible HIV exposure at Buffalo VA hospital. Jan 13, 2013. www.usatoday.com/story/news/nation/2013/01/13/veterans-hospital-hiv/1831705/
18. Institute for Safe Medication Practices. [accessed 2015 Dec 28] Olean General alerts patients to possible insulin pen re-use. Jan 24, 2013. www.ismp.org/sc?id=420
19. [accessed 2017 Sep 9] 3,100 Griffin Hospital patients at risk of disease after misuse of insulin pens. May 16, 2014. www.ctpost.com/local/article/More-than-3-100-diabetes-patients-exposed-to-HIV-5484528.php
20. Institute for Safe Medication Practices. [accessed 2015 Dec 28] A crack in our best armor: “wrong patient” insulin pen injections alarmingly frequent even with barcode scanning. Oct 23, 2014. www.ismp.org/newsletters/acutecare/showarticle.aspx?id=92
21. Cobaugh DJ, Maynard G, Cooper L, et al. Enhancing insulin-use safety in hospitals: practical recommendations from an ASHP Foundation expert consensus panel. *Am J Health-Syst Pharm.* 2013; 70:1404–13. [PubMed: 23903479]
22. Centers for Disease Control and Prevention. [accessed 2016 Oct 24] CDC clinical reminder: insulin pens must never be used for more than one person. Jan 5, 2012. www.cdc.gov/injectionsafety/clinical-reminders/insulin-pens.html
23. Food and Drug Administration. [accessed 2016 Oct 24] Information for healthcare professionals: risk of transmission of blood-borne pathogens from shared use of insulin pens. Mar 19, 2009. www.fda.gov/Drugs/DrugSafety/PostmarketDrugSafetyInformation-forPatientsandProviders/DrugSafety-InformationforHealthcareProfessionals/ucm133352.htm

24. Hakre S, Upshaw-Combs DR, Sanders-Buell EE, et al. An investigation of bloodborne pathogen transmission due to multipatient sharing of insulin pens. *Mil Med.* 2012; 177:930–8. [PubMed: 22934373]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

KEY POINTS

- Institutional policies governing insulin pen storage can be difficult to follow, and evaluation of existing policies is important to ensure that they are serving the intended purpose.
- Policies governing medication storage that are developed with careful consideration of nursing workflow are likely to promote higher adherence.
- It is important for pharmacists to involve members of other healthcare disciplines in implementing medication-related policies to help ensure that they are easy to follow.

Figure 1. Regulator Insulin Pen Box (Health Care Logistics, Inc., Circleville, OH). The clear locking box was mounted on a wall of each patient room on intervention units at the study site.

Table 1Characterization of Nonadherence to Insulin Pen Storage Policy at Study Site^a

Variable	Control Units (<i>n</i> = 4)		Intervention Units (<i>n</i> = 4)	
	Phase 1 (pre)	Phase 2 (post)	Phase 1 (pre)	Phase 2 (post)
Total no. insulin orders	272	227	283	280
No. incidents, by type				
Unsecured in correct room	70	44	80	5
Nurse's pocket	13	12	10	2
Incorrect medication drawer	9	0	8	5
Incorrect room	2	0	2	0
Incorrect box	...	...	...	1
Medication drawer for empty room ^c	15	18	19	3
Unsecured in empty room ^c	6	1	0	0
Box in empty room ^c	...	...	...	4

^a pre = preintervention, post = postintervention.^b Not applicable.^c For audits, the finding of an empty room was deemed to indicate that the patient had been transferred or discharged.